

Claims

1. Data channel of the background containing symbolic data marks, which include aggregate, constant number of dark elements in the whole record, which is characterized by:
recording medium, such as paper or other recording print carrier,
data symbolic marks printed on record medium arranged into a grid on positions with periodically repeating properties in both horizontal and vertical directions,
textual or graphical print printed in overlay with data symbolic marks,
elements of modulation of the record by graphic pattern.
2. System for data recording on paper, or other carrier, and reading machine readable marks, which is characterized by:
means for transforming and formatting source data to a sequence of digital data embedded in individual symbolic data marks;
means for coding such data sequence onto a format consisting of a description of a symbolic data mark in the language of the used printing method;
means dedicated for printing a record on paper or other printing substrate,
means for reading data symbolic marks from paper or other carrier into a computer;
means for transforming the read data of the data sequence format which are represented by individual symbolic data marks;
means for transforming into the format of data which served as a source for recording symbolic data marks or to other chosen format;
means for modulation of marks by a source graphic pattern.
3. Method of recording, determination of the location and number of dark elements for coding dual represented statuses in a symbolic data mark for data recording and reading on paper or other carrier of such mark, wherein these dark elements represent on an area available for one symbolic mark two statuses with constant number of dark elements, which change only position, is characterized by:
determination of the axes of symmetry of a two-dimensional area dedicated for a symmetric data mark and determination of a coordinate system in regard to these symmetry axes,
determination of the aggregate area of the mark, i.e. the number of dark elements used for coding two statuses for data representation on area allocated for the symbolic data mark,
determination of the maximal allowed distance of dark points from a line of equal distance from both the axes of symmetry and minimal allowed distance from each of the symmetry axes,

calculation of the aggregate of the absolute values of both co-ordinates for each possible location of a dark element,

determination of areas of maximal distance from both the axes in compliance with the aggregate and allowed maximal and minimal distances from axes,

recording one half of the maximal allowed number of elements in one of the areas determined in previous step within the limits of the area allocated for the symbolic data mark as one half of a symbol representing one of the two statuses which could be represented by the symbolic data mark,

recording the second half of the maximal allowed number of elements in the next of the determined areas on the opposite side of both the symmetry axes, within the limits of the area allocated for the symbolic data mark as the second half of the symbol representing one of the two statuses which could be represented by the symbolic data mark, choosing the locations of dark elements located symmetrically to the second symmetry axis with respect to the recorded elements as locations of elements representing the second status of two statuses representing the symmetric data mark,

determination of the areas of maximal distance from each of the symmetry axes individually,

recording the maximal allowed number of elements in one of the determined areas within the limits of the area allocated for the symbolic data mark as a symbol representing one of the two statuses which could be represented by the symbolic data mark,

choosing the locations of dark elements located symmetrically to such an axis of symmetry that does not intersect the chosen locations of dark elements with respect to the recorded elements as the locations of the elements representing the second status of the two statuses represented by the symbolic data mark.

4. Method of recording according to claim 3, where reading marks and the data status represented by them on expected area of paper or other carrier containing dark and light elements and allocated for the symbolic mark is characterized by the fact that it consists of:

evaluation of the status of areas minimally in four corners of a rectangular with maximal dimension allowed for arrangement of the mark with regard to presence of dark elements in a number greater than a certain threshold p ,

determination of one status from the collection of possible statuses of the evaluated areas of the read mark according to over-threshold number of dark elements presented in the four areas evaluated in the previous step minimally,

determination of the data value represented by the symbolic mark in the case of the first sub-

collection of statuses of the areas evaluated in previous step, which is characterised by presence of dark elements in over-threshold number in two diagonally opposite areas or also in the third of four evaluated areas,

evaluation of the statuses of four areas located always on the shortest non-diagonal connection line between two areas evaluated in previously mentioned step in the case of the second sub-collection of the statuses of the areas evaluated in previously mentioned step, which is characterised by a number of dark elements presented in over-threshold number in two non-diagonal or in all four evaluated areas, or those characterised by an under-threshold number of dark elements in all four evaluated areas in previously mentioned step,

determination of the represented data value of the symbolic mark in the case of the second sub-collection of the areas evaluated in previously mentioned step according to the result of evaluation of the status of four areas evaluated in previously mentioned step,

repeating of the previous step sequence, but with the centre of the evaluated rectangular moved to the corner area that was evaluated before with presence of dark elements presented in a number above the number p , in the case of the third sub-collection of the areas evaluated before, which is characterised by presence of dark elements in over-threshold number in one of the evaluated areas only,

determination of the represented data value of the symbolic mark, if repeating of the previous steps initialised by the previous step results at the second execution of step 2.6 in a return of the centre of the evaluated rectangle towards the original position of the beginning of the process of reading the mark,

correction of the expected location of the following read symbolic marks according to the results of previous steps.

5. Method of recording according to claim 3, consisting in modulation of the total aggregate quantity value of the dark elements of the symbolic data mark, which is characterised by the fact that it consists of:

selection of the number of dark elements from interval from 0 to the maximal allowed number of dark elements, that is appropriate to the quantity value level of the corresponding point of the pattern that is viewed by modulation on the grid of symbolic data marks,

adding the selected number of dark elements onto positions nearest to both symmetry axes of the data symbolic mark, preferring an even number located symmetrically to both symmetry axes,

adding the number of dark elements selected in the previous step onto free locations adjacent to the elements representing each data status with the maximal distance from both symmetry axes.

6. Method of recording according to claim 3, consisting in initial localisation of the locations of the beginnings and ends of the rows and columns of symbolic data marks, which is characterised by the fact that it involves:

evaluation of the scanned field representing the bright value of the image points of the read document in one direction horizontally or vertically, point by point,

evaluation of successive image points from a margin of the paper or other carrier, where a change to under-threshold value and back must occur $\underline{1}$ times with an average periodicity of \underline{m} points, wherein such a first point with an over-threshold value represents one of the minimums of the horizontal or vertical co-ordinates, which specify origins of the rows or columns,

creation of a curve of the minimums \underline{F} obtained in the previous step,

filtration of the points of the curve \underline{F} obtained in the previous step by elimination of extreme values through a substituting for all points an average of \underline{p} points, which are symmetrically placed around the substituted point of the original curve,

creation of a straight line of a linear approximation of the filtered curve,

placing a straight line \underline{R} parallel to the straight line of the linear approximation, all co-ordinates of which are smaller than those of the point with the minimal co-ordinate in horizontal or vertical direction,

translation moving of the straight line \underline{R} towards the found points,

finding a first intersection \underline{Q} of the moved straight line \underline{R} with the filtered curve \underline{F} of the minimums from previous step,

rotating the straight line \underline{R} around the point \underline{Q} till a next intersection \underline{D} with the filtered curve \underline{F} is found,

eliminating the points of the curve \underline{F} , which are more distant to the straight line \underline{R} located in the position found in previous step than the distance \underline{q} , and obtaining a resulting curve \underline{S} ,

finding the nearest point of the curve \underline{F} to the straight line \underline{R} in each of point clusters, where these clusters are of an average periodicity of \underline{h} (vertically) or \underline{m} (horizontally),

repeating the previous steps in the next three directions i.e. for vertical direction, for the horizontal direction backwards to previous points and for vertical direction backwards to the first executed vertical direction,

detecting of perpendicularity and parallelism to each other of the resulted straight lines, correction of a line, which is neither perpendicular nor parallel to any straight lines of the three left,

determination of the margins of the field of the marks according to at least three straight lines.

7. Method of recording symbolic data marks by means of dark and light elements placed on paper or a similar carrier of print information, which is characterised by the fact that it involves:

defining a grid of two systems of axes, a horizontal one and a vertical one, perpendicular to each other with equal or different relative distance in horizontal and vertical directions, on a paper area dedicated for recording symbolic data marks,

determining a maximal allowed number of dark elements for a symbolic data mark,

placing one system of symbolic data marks onto the area of lines connecting two intersections of each horizontal axis with vertical axes in a way, that a one logical status represented by the symbolic data mark has the majority or all of its dark elements placed on one half of the mentioned connecting line or close to it and the second logical status represented by the symbolic data mark has the majority or all its dark elements placed on the second half of the mentioned connection line or close to it,

placing the second system of symbolic data marks in the area of lines connecting two intersections of each vertical axis with horizontal axes so that a one logical status represented by the symbolic data mark has the majority or all of its dark elements placed on one a half of the mentioned connecting line or close to it and the second logical status represented by the symbolic data mark has the majority or all its dark elements placed on the second half of the mentioned connection line or close to it,

placing dark elements to positions maximal outlying to the centre of a line connecting intersections of the two systems of axes,

placing the dark elements of the mark in such a way, that they are in minimal allowed distance y from the mentioned intersections of the horizontal and vertical axes,

placing the dark elements of the mark in such a way, that they are in maximal distance d from a line connecting intersections of the horizontal and vertical axes.

8. Method of recording of symbolic data marks according to claim 5 and the data status represented thereby on an expected area of paper or other carrier containing dark and light elements and allocated for a symbolic mark, which is characterised by the fact that it includes:

result of comparison of the quantitative values compared in the previous step,
usage of the corrections of the vertical and horizontal expected positions of adjacent marks
determined in previous steps prior to their evaluation according to the sequence of
previous steps.

9. Method of recording according to claim 7 with modulation of an area of a
document by modulating marks inserted onto a field of placed symmetric data marks, where
the marks are recorded on paper or other carrier by graphical information, which is
characterised by the fact that it involves:

transformation of graphical information from the original format of modulating marks to
such format that is given by a sub-collection of a grid of symbolic marks specified for
inserting modulating marks and determination of quantitative parameters of individual
modulating marks,

transformation of the quantitative parameters of individual modulating marks into a sub-
collection of the dark elements creating such modulating mark,
recording the collection of dark elements creating individual data modulating marks on an
area near to the points which are evenly distant from the vertical as well as horizontal axes
that determine the location of symbolic data marks according to claim 7.

10. Method of recording according to claim 7 with searching of the co-ordinates of the
beginnings and ends of the rows and columns of the horizontal and vertical lines on which
symbolic data marks are placed, which is characterised by the fact that it consists of:

evaluation of plurality of n horizontal lines arranged basically throughout the whole vertical
length of a margin of dark points, proceeding horizontally from a one margin of the scanned
paper, or other substrate up to a point, in which the dark points are presented in a number
higher than the threshold p_z value,

leading a linear approximation through all points specified in the previous step,
elimination of the points, which are more distant from the straight line of that linear
approximation than a distance v_i ,

leading a new linear approximation through points, which remained from the previous step,
elimination of the points, which are more distant from the straight line of the new
linear approximation than a distance $V_{j+i} < V_i$,

repeating the previous step still $V_i < H$,

repeating the previous steps in a backward horizontal direction from the second margin of the
paper,

evaluation of status of chosen areas on either sides from the centre of an expected horizontal connection line between two intersections of horizontal and vertical axes as regards presence of dark elements and their quantitative values,

comparison of the aggregate of quantitative values of the dark elements located in the chosen areas on one side from the centre of the mentioned connecting line towards the first intersection of axes with the aggregate of the quantitative values of the dark elements located in the chosen areas on the other side from the centre of the mentioned connecting line towards the second intersection of the axes,

comparison of the aggregate of quantitative values of the dark elements located in the chosen areas on one side of the mentioned connecting line with the aggregate of the quantitative values of the dark elements located in the chosen areas on the other side of the mentioned connecting line,

determination of represented data value of the symbolic data mark according to result of comparison of the quantitative values compared in the previous step,

determination of the size of correction of the expected position of evaluated symbolic data mark, adjacent and near marks, in particular in the vertical direction according to result of comparison of the quantitative values compared in the previous step,

evaluation of the status of chosen areas on either sides from the centre of expected vertical connection line between two intersections of vertical and horizontal axes as regards presence of dark elements and their quantitative values,

comparison of the aggregate of the quantitative values of the dark elements located in the chosen areas on one side from the centre of the mentioned connecting line towards the first intersection of the axes with the aggregate of the quantitative values of the dark elements located in the chosen areas on the other side from the centre of the mentioned connecting line towards the second intersection of the axes,

comparison of the aggregate of the quantitative values of the dark elements located in the chosen areas on one side of the mentioned vertical connecting line with the aggregate of the quantitative values of the dark elements located in the chosen areas on the other side of the mentioned vertical connecting line,

determination of the represented data value of the symbolic data mark according to the result of the comparison of the quantitative values compared in the previous step,

determination of size of correction of the expected position of the evaluated symbolic data mark, adjacent and near marks, in particular in the horizontal direction according to

repeating the previous steps in both vertical directions, i.e. in the direction of columns, for selected horizontal direction of evaluation of symbolic data marks (rows), a straight line will be led parallel to the straight line of linear approximation of expected beginnings of rows in distance equal to one half distance of the vertical lines of the symbolic data marks location, whereon symbolic data marks of the first system of symbolic data marks are located, finding the first symbolic data mark on the straight line led in the previous step, in distance equal to a half distance of the horizontal lines of the location of the second system of symbolic data marks from the straight line of linear approximation of the expected beginnings of columns obtained in the previous, finding next marks according claim 8.

11. Method of recording according to claims 3 or 7, where dark elements can be of next characteristics differentiating them from light elements, which is characterised by the fact that it involves:

dark elements having quantitative values or value intervals of a value scale of an arbitrary optical characteristic representing two logical statuses of a data symbolic mark, wherein these dark elements consist of a one or more image elements (pixels) having a higher quantitative value or interval of the value scale of the optical characteristic chosen for representation of the two statuses,

dark elements according to the previous point, where the surroundings of a symbolic data mark is of a quantitative value or interval different from two values or intervals representing two statuses of the symbolic data mark,

dark elements with an optical characteristic of a half tone scale,

dark elements with an optical characteristic of a colour scale.

12. Method of preparation of data channel of the background according to claim 3 or 7, which is characterised by the fact that it consists of a human readable text or graphical patterns in overlay with data symbolic marks.

13. Method according to claim 12, which is characterised by the fact that the data channel contains data that represent human readable data printed on the same substrate or transformation of such data or pattern readable by a human.

14. Method according to claim 12, which is characterised by the fact that the data channel contains also safety protection, e.g. electronic signature, human readable data printed on the same substrate.

15. Method of transparent protection of a document dedicated for printing which

is transparent in regard to application as well as to the inherent data contents of the document by means of a field of symbolic data marks, in particular according to claims 3 or 7, wherein this field is printed in overlay by print of the inherent document, wherein this protection provides selective data and security continuity of electronic and paper document in both directions, i.e. from electronic version of the document to form printable on paper and from paper form of the document back to electronic version of the document which characterized by the following steps:

extracting a part of data contents dedicated for document protection which can include also positional information on the printed document from the file dedicated for print by the original application,

extracting other document contents, including also invariable data in a set of documents of the same kind, from the file dedicated for print by the original application,

transforming data extracted in the first or also in second step, according to a set of algorithms including also cryptographic, compress algorithms and procedures, electronic signature, self corrective coding and data preparation for mark modulation by a graphic information,

transforming the data from the previous step to a form suitable for printing a field of two-dimensional symbolic data marks representing the mentioned data, for instance such as described in other items of this invention, but not limited on those only, arranged in rows and columns placed in the print document on a substantial document area, principally independently of the area used for printing the original document, the complete file data of which were used as input in the previous step,

printing carried out by overlaying a print of the original document that is printed concurrently or in time sequence with the print of two-dimensional data symbol marks on paper or another carrier,

scanning the printed protected document by a scanner or other similar equipment,

and input of the scanned data into computer,

processing the read data of the mutually overlaid print of the original document by a field of symbolic data marks, recognising, extraction of data represented by the field of symbolic data marks,

transforming the recognised and extracted data by a set of algorithms including also cryptographic, decompress algorithms and procedures, electronic signature, self corrective decoding,

visualisation on a visualising equipment of the recognised and processed data, i.e.

the part of data contents determined for protection,
linking the recognised and processed data from the previous step with the data of other document contents from the previous step till full reconstruction of the file document in its complete form as it was used for purposes of previous steps , however not limited on complete form only,
visualisation of the complete document on a visualising equipment.